EPIGENETIC REGULATION OF PROTEIN BIOSYNTHESIS BY SCALE RESONANCE

Invited lecture by Joël Sternheimer

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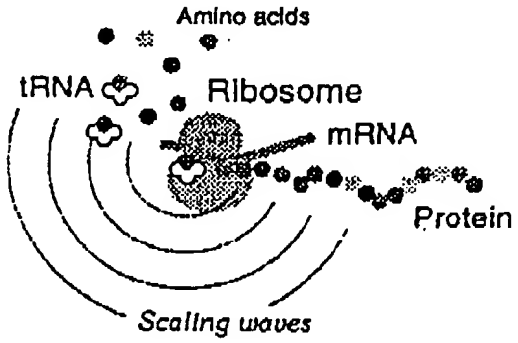
I do not know whether you've been told, before coming here, that this lecture is about the fact that certain molecules are (in a sense) 'musical', and that this has applications for healing; so I'll tell you how, what it means, and in which sense. Only forgive me that I will start recalling a few things most of you probably already know.

When we eat, we digest and decompose our nutriments into simple elements, namely fat, sugars and amino-acids. Then using our genetic program, which is contained in our DNA, we build up our own proteins from amino-acids we eat and others we make ourselves.

Starting from DNA [drawing], one has the messenger RNA (mRNA) which goes on to the ribosome; whose shape looks a bit like Akebono [famous Sumo fighter], and indeed somehow possesses its stability: it is a very stable place, a kind of bench on which protein synthesis will be performed.

On the other hand, one has amino-acids which are carried by transfer RNAs. The mRNA goes onto the ribosome, and the transfer RNA (tRNA) which carries the amino-acid also goes onto the mRNA which is on the ribosome. Here you see the two parts which are called subunits of the ribosome, over which comes the mRNA, over which again comes the tRNA with its amino-acid. Then there is a displacement and the amino-acid which is brought by its tRNA gets onto another (more exactly others are already there) at the end of a protein chain in the course of its elongation process. Here [pointing onto the board] is another tRNA which carries an amino-acid and a second one linked to the first, and a third, and a fourth and so on, that is an amino-acid chain.

Of course, all this you find in any biology textbook. But what interests us more particularly here, is what happens at the very moment when the amino-acid brought by its tRNA is being hooked onto the ribosome.



Something happens then which you do not yet find in your books, namely that the amino-acid, at that moment, emits a signal. This signal is a wave of a quantum nature which is precisely called a scaling wave (1). This means that it connects different scales together, and more particularly the scale of each amino-acid to the scale of the processing protein.

This signal has a certain frequency and a certain wavelength. Its wavelength is given by a very

classical formula. It is the ratio of Planck's constant over the product of the mass times the speed of the amino-acid. When the amino-acid is in its free state, its wavelength is much smaller than its size and it behaves like a particle submitted to thermal agitation.

But when the amino-acid is being hooked onto the tRNA, its wavelength becomes of the order of its size, because it is strongly slowened by the tRNA, and its wavelength, which is inversely proportional to its speed, then increases to the order of the amino-acid size. And when this whole system is in turn hooked onto the ribosome, which is still about 200 times bigger than the tRNA, the amino-acid wavelength then becomes much larger than its size, perhaps about 5 to 6 times in average. This means that at this moment the behaviour of the amino-acid becomes wavelike, which is expressed by the fact that when the system is being hooked onto the ribosome, the amino-acid emits a signal.

The equation of motion of this wave is not a simple Schrödinger or Klein-Gordon equation. It is a scaling wave equation, as follows:

$$\Box\, e^{-2i\alpha\partial/\partial s}\,\Psi = m^2\,\Psi$$

so that without the exponential term that you see here, it would be the Klein-Gordon equation, but with this term which includes a scale parameter, the wave also propagates in scale, and therefore connects different scales together. The general solution of this equation is very peculiar: it is a sum of waves analogous to light waves, but with speeds that are different. There is a fastest one and another one twice as slow, and still another one three times as slow, and so on.

I will here show in bigger size what I draw earlier. The individual amino-acid on one side, and the processing protein chain on the other. At a given moment, a wave is emitted from an amino-acid, then a slower one will arrive after a time twice as long, and a third one will arrive after a time three times as long, and so on. One will get periodic superpositions of the vibrations of these amino-acids.

As each of those vibrations itself contains harmonics, the neat result will be the existence of constraints in the succession of frequencies of those amino-acids, and so in the succession of the amino-acids themselves which will therefore be not random in the protein: namely these superposition properties draw along the succession of those frequencies to be musical. Take for example a well-known protein which is the one before last protein of the respiratory chain, and is called cytochrome C:

G D V E K G K K I F I M K C S Q C H T V E K G G...

Here is just the beginning, the first 24 amino-acids of human cytochrome C. If one looks at the succession, G in the one-letter code for amino-acids stands for glycin for instance; D is aspartic acid, V is valine, and so on...

If one looks at the frequencies associated with each of these amino-acids, as it is possible to compute them -- the calculation is rather complex, but results in a code which is fairly simple -- well, modulo a certain number of octaves (approximately 76 octaves, since the magnitude of those amino-acid frequencies, namely of the signal emitted from them, is of the order of about 10^{25} Hertz), then precisely, the frequency for glycin will be 220×2^{76} Hertz; similarly for serin it will be 330, for the one coming next in the sequence 440, always modulo 76 octaves, that is times 2^{76} Hertz.

Those frequencies are musical [pointing onto the amino-acids of the sequence written on board], here is an A, here an E, and here again an A an octave higher; and if one looks at the

succession of the frequencies and enters it into the memory of a synthetizer, one gets a melody.

Glycin is an A, asparagin is a G, valin is an F, so one gets [singing the melody], and it goes on [following of the melody singing]... I hope I did not sing it too bad, but if it gave you a somehow nice feeling, this is probably not by mere chance, but because... well here I am going a bit too fast, so let us take over again.

When the cytochrome C molecule is being processed, the scaling waves it emits do not bound themselves to stimulate, to act on the protein itself, but they also act on other proteins of the organism. The melody I just sang before you involved approximately 4 to 6 notes per second, corresponding to 4 to 6 amino-acids per second: this does correspond to the biosynthesis of the cytochrome C molecule, where 1/4th of a second represents the average time it takes a new amino-acid to get hooked on the elongating chain.

When for instance we breathe, a whole series of reactions is taking place. Breathing is the reaction $H^2 + 1/2\ O^2 \rightarrow H^2O$, in which the energy is stored by a whole series of molecules which transfer electrons, the one before last being the cytochrome C, and the last one the cytochrome oxidase or cytochrome A3; and if I look at the melody associated to the synthesis of cytochrome oxidase, I find inside the same musical fragment [singing] that is found here round the beginning of cytochrome C. This expresses the fact that, when the cytochrome oxidase molecule is being processed, it will stimulate again the synthesis of the cytochrome C protein, so that these melodies are not just a kind of molecular amusement, so to speak: they sign up the function of the protein.

The proteins which share similar melodies will find themselves homologous in a metabolic chain. They will stimulate each other like those.

The proteins whose melodies correspond to scaling waves in phase opposition, will yield other melodies and will find themselves anti-homologous. There will be a phase opposition, which will inhibit synthesis. Thus, when we make our own proteins, by the very fact that we make them and through the scaling waves they emit, they will stimulate or inhibit other proteins. So the synthesis of a protein when we are making it will have an action on other proteins of our organism.

As an example when we are making interleukin 2, or when we are making tPA (tissue plasminogen activator), we are not only making them, we also stimulate other proteins (of immune defense in the first case). Interleukin is something like this [singing]. Here I am a bit cautious, I stop rather quickly, I shall explain why; but when we make it, we stimulate other immune defence molecules, which is not at all the case when the protein is for instance produced by genetic engineering and injected into the body. All those effects are lost when a protein is injected that we do not make ourselves. Therefore one would need much more of it to get similar results, and that is why one gets side effects. So in this case it is better (and much more interesting) to stimulate our own proteins, rather than adding them from outside; one will not get those obnoxious side effects.

That is now that something interesting happens when one listens to those melodies such as the ones I sang you a bit earlier, which are transpositions down 76 octaves, of the quantum melodies of proteins.

In our ear (here I draw an ear), inside there is a small shell that is called the cochlea, and inside this cochlea, are found the so-called hair-cells. In those hair cells, the acoustic wave which is recieved in the ear is transformed into electric current which is called microphonic potential because it exactly reproduces the shape of the acoustic wave like a microphone. All those microphonic potentials, of course, sum up in the nervous impulse (or summation potential).

But before the nervous impulse goes to the brain, the microphonic potential, who also obeys an equation of this type [showing the scaling wave equation written on the board], sends scaling waves which go directly onto the ribosomes. Scaling waves indeed have quantized ranges: there are several solutions, but one in particular is close to Avogadro's number, and can thus achieve a transposition between the quantum scale and our scale. The electric current which is called microphonic potential, and which reproduces the shape of the acoustic wave, thus sends a signal which is a scaling wave and reaches directly onto the ribosomes where protein synthesis is taking place.

So we have two circuits for hearing. One goes to the brain, with the interpretation of acoustic signals by the brain, and there is another one which, starting from cochlear hair cells, reaches directly onto cellular ribosomes.

When we listen to the melody of a protein transposed, when we listen to it acoustically, a resonance phenomenon occurs, which is a scale resonance, and will stimulate (or inhibit in case of phase opposition) the corresponding protein synthesis.

Since, happily enough, we also have a brain with its own circuits (otherwise it would be very dangerous), we can be aware and consciously know whether the sequence of sounds, the melody we listen to is convenient for us, whether we like it or not. If it is not convenient, we can protect us from it -- we can close our ears -- but if it is, we can acknowledge it and heal ourselves in this way. So there is a whole therapy based on this principle, and which consists, when somebody is sick for some reason, in making the hypothesis that may be this or that gene is involved; so that the corresponding protein should accordingly be stimulated, or inhibited. And one proposes it to the person to listen to. Only she can then know whether the corresponding melody is convenient for her; in which case she will listen to it, and this will stimulate the synthesis of the protein which was deficient. (...).

[Original transcription by Jérôme Baron, translation by author].

(*) After J. Sternheimer, Method for the epigenetic regulation of protein biosynthesis by scale resonance, patent n° FR 92 06765 (international application n° PCT n° FR 93/00524).

(1) J. Sternheimer, in Colloque International "Louis de Broglie, physicien et penseur", Ancienne Ecole Polytechnique, Paris, nov. 5-6, 1987; and Scaling waves, to be published.